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EXAMINER

TOLEDO, FERNANDO L

| | |
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| ART UNIT | PAPER NUMBER |
|----------|--------------|

2823

DATE MAILED: 07/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/688,817

Applicant(s)

SHAN, ET AL.

Examiner

Fernando Toledo

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 April 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 17 October 2000 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892) 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948) 5) ☐ Notice of Informal Patent Application (PTO-152)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ 6) ☐ Other: _____

DETAILED ACTION

Specification

1. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Double Patenting

2. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. See *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and, *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent is shown to be commonly owned with this application. See 37 CFR 1.130(b).

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

3. Claims 1 – 21 and 24 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 – 24 of U.S. Patent No. 6,140,228. Although the conflicting claims are not identical, they are not patentably distinct from each other because the U. S. patent 6,140,228 claims a specific range of temperature and power while the present application claims "that the deposition of a second amount of metal on the seed layer at a substrate temperature and power" with no specific temperature or power.

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However, the temperature and power claimed in U. S. patent 6,140,228 encompass the claimed temperature and power of the present application.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to deposit a second amount of metal on the seed layer at a substrate temperature and power, since the U. S. patent 6,140,228 deposits the same second amount of metal at a defined temperature and defined power.

4. Claims 22 and 23 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1 – 24 of U.S. Patent No. 6,140,228 in view of Xu et al. U. S. patent 6,217,721 B1. The U. S. patent 6,140,228 does not claim the formation of TiAl_3 .

However, Xu et al. in the U. S. patent 6,217,721 B1 discloses forming a plug in a high aspect ratio hole with aluminum and a Ti or Ti compound as a wetting or barrier layer and that the combination of Al with Ti will form TiAl_3 if proper steps are not taken. It would have been obvious to one of ordinary skill in the art at the time the invention was made to form TiAl_3 in the U. S. patent 6,140,228; because as taught by Xu, TiAl_3 can be readily formed with Al and Ti if proper steps are not taken.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application

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by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) do not apply to the examination of this application as the application being examined was not (1) filed on or after November 29, 2000, or (2) voluntarily published under 35 U.S.C. 122(b). Therefore, this application is examined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

6. Claim 21 is rejected under 35 U.S.C. 102(e) as being anticipated by Xu et al. (U. S. patent 6,217,721 B1).

Xu in the U. S. patent 6,217,721 B1; figures 1 – 22 and related text discloses i) depositing a seed layer of the metal on a first substrate surface, the seed layer being sufficient to cover the first substrate surface (column 20); ii) depositing a second amount of metal on the seed layer at a substrate temperature and power that are sufficient to (i) inhibit formation of filamentous metal phases (i.e. TiAl_3) having a resistivity greater than that of the metal and (ii) provide a metal diffusion rate and a metal deposition rate sufficient to inhibit void formation in an opening having an aspect ratio of at least 2.0 (columns 3, 23 and 24); iii) depositing a third amount of metal on the second amount of metal (figures 16 and 17).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. Claims 1 – 13, 16 – 20 and 22 – 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xu.

In re claims 1, 22 – 24 Xu in the U. S. patent 6,217,721 B1; figures 1 – 22 and related text discloses i) depositing a seed layer of the metal on a first substrate surface, the seed layer being sufficient to cover the first substrate surface (column 20); ii) depositing a second amount of metal on the seed layer at a substrate temperature and power that are sufficient to (i) inhibit formation of filamentous metal phases (i.e. TiAl_3) having a resistivity greater than that of the metal and (ii) provide a metal diffusion rate and a metal deposition rate sufficient to inhibit void formation in an opening having an aspect ratio of at least 2.0 (columns 3, 23 and 24); iii) depositing a third amount of metal on the second amount of metal (figures 16 and 17).

Xu teaches that the temperature is 200°C.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to have the temperature from 220 to 300°C in the invention of Xu, since temperature is a process variable and identifying the optimum or workable ranges require only routine experimentation by one of ordinary skill in the art. Note that the specification contains no disclosure of either the critical nature of the claimed temperature range or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen temperature range or upon another variable

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recited in a claim, the Applicant must show that the chosen temperature range is critical.

In re Woodruf, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

In re claim 2, Xu discloses wherein the substrate further comprises a hole (figure 8).

In re claim 3, Xu discloses before step i) forming a barrier/liner layer in the via channel (column 12, figure 8).

In re claim 4, Xu discloses wherein step ii) is conducted at a substrate temperature and a power sufficient to inhibit formation of filamentous metal phases (i.e. TiAl_3) with the barrier/liner layer, having resistivity greater than that of the metal (column 23).

In re claim 5, Xu discloses wherein the second amount of metal is deposited at a rate of about 5 to 30 Å/sec. (figure 15).

In re claim 6, Xu teaches that the second amount of metal is deposited at a pressure of 0.5 to 2 mTorr (column 24). Xu does not teach wherein the pressure is 4 to 6 mTorr.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to deposit the second amount of metal at 4 to 6 mTorr, since it has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. Note that the specification contains no disclosure of either the critical nature of the claimed pressure or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen pressure or

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upon another variable recited in a claim, the Applicant must show that the chosen pressure are critical. In re Woodruf, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

In re claim 7, Xu discloses wherein the second amount of metal is deposited at a substrate temperature of 300 to 420°C (column 24).

In re claim 8, Xu discloses wherein the second amount of metal is deposited to form a layer of 400 to 3,000 Å thick (figure 15).

In re claim 9, Xu discloses wherein the metal is aluminum (column 24).

In re claim 10, Xu discloses depositing the seed layer at a power of 9,000W (i.e. 9kW) (column 15).

In re claim 11, Xu discloses wherein the seed layer is deposited at a pressure of 1 to 3 mTorr (column 15).

In re claim 12, Xu discloses wherein the seed layer is deposited at a rate of 100 to 200 Å/sec (column 20).

In re claim 13, Xu discloses wherein the seed layer is deposited to form a layer of 500 to 4,000 Å (column 20).

In re claim 16, Xu discloses wherein the opening has an aspect ratio of at least 3:1 (column 2).

In re claim 17, Xu discloses wherein the second amount of metal deposited is sufficient to fill the opening (figure 8).

In re claim 18, Xu discloses further including forming a liner/wetting layer is deposited in the opening before step i) (column 12).

In re claim 19, Xu discloses wherein the second amount of metal is deposited at a power of 100 to 800 W (column 20).

In re claim 20, Xu discloses wherein the opening has an aspect ratio of 2.5 (column 2).

8. Claims 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Xu as applied to claims 1 – 13, 16 – 20 and 22 – 24 above, and further in view of Moon, Jong (U. S. patent 5,660,696 A).

In re claims 14 and 15, Xu does not show wherein the heating is done by backside gas flow, wherein the gas is argon.

However, Moon in the U. S. patent 5,660,696 A; figures 1 – 12 and related text, discloses as conventional to use a backside gas flow (argon) to heat a substrate in a sputtering technique (Column 4, Lines 26 – 30).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use argon as a backside gas flow to heat the wafer in a sputtering process in the invention of Xu, because, as taught by Moon, it is a conventional technique for heating the wafer in a sputtering process.

Response to Arguments

9. Applicant's arguments filed 28 April 2003 have been fully considered but they are not persuasive for the following reasons.

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10. Applicant contests that Xu fails to disclose or suggest a method in which the first amount of metal is deposited at a substrate temperature and power sufficient to inhibit formation of a filamentous metal phases having a resistivity greater than that of the metal and inhibit void formation in an opening having an aspect ratio of at least 2.0.

Examiner respectfully submits that Xu does disclose a method in which the first amount of metal is deposited at a substrate temperature and power sufficient to inhibit formation of a filamentous metal phases having a resistivity greater than that of the metal and inhibit void formation in an opening having an aspect ratio of at least 2.0. Xu discloses setting a power and a temperature to deposit the metal layer to prevent a filamentous metal phase from depositing. Xu, on column 23, lines 34 – 47 discuss the importance of inhibiting the growth of such metal phases also on column 24, lines 62 – 67 and continuing on column 25, lines 1 – 4. Also claim 41, discloses that a fourth metal layer is deposited at a certain power and temperature, which, will inhibit the formation of the filamentous metal phases.

11. Applicant contests that Xu fails to suggest depositing a seed layer on a substrate surface of Ti at a temperature of 220 to 300°C.

Examiner respectfully submits that although Xu prefers the deposition of 200°C. Xu discloses that the deposition of the Al seed layer can be done by the process of Wang, which suggests a cold deposition of 50 to 250°C (Column 24; Lines 12 – 13).

Teaching another way is a broad concept. It refers to a situation where a reference teaches a preferred, a better or an alternative way to a claimed way of accomplishing something. A reference must be considered for all it teaches. *Ashland*

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Oil Inc. v. Delta Resins & Refractories Inc., 776 F.2d 281, 296, 227 USPQ 657, 666 (Fed. Cir. 1985). Preferred embodiments and disclosed examples do not constitute a teaching away from a broader disclosure or nonpreferred embodiments. *Merck & Co. v. Biocraft Labs.*, 874 F.2d 804, 807, 10 USPQ2d 1843, 1846 (Fed. Cir. 1989); *In re Mills*, 470 F.2d 649, 650, 176 USPQ 196, 198 (CCPA 1972). Similarly, a statement that a first product is somewhat inferior to another product for the same use does not teach away when the reference also discloses that the first offers acceptable advantages. *In re Gurley*, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994).

It is not necessary for Xu to disclose solving the same problem or obtaining the same advantages as the primary reference discloses. It is sufficient that there is motivation to combine the references and that the process of the combination is encompassed by the instant claims.

12. Applicant contests that Xu fails to disclose or suggest a method in which the metal is deposited on a seed layer in at least two steps.

Examiner respectfully submits that Xu deposits the metal in two steps. It safe to assume that at any given point in time of the second deposition of aluminum (i.e. the hot deposition), it can be the end of one step and the beginning of another step. Therefore, Xu teaches a two-step process.

13. In regards to claim 5; Applicant contests that Xu does not teach the rate of deposition to be 5 to 30Å/sec.

Examiner respectfully submits that Figure 15 shows the optimal deposition parameters of the aluminum. On column 24, lines 30 – 43, shows that for an 800 nm

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(i.e. 8,000 Å) is deposited in 4 minutes (Figure 15), dividing 8,000 Å by 240 seconds would give 33.33 Å/sec. At longer times (which also fall between the margins of Figure 15) will give the 30 Å/sec. Therefore, Xu teaches the limitation of claim 5.

14. In regards to claim 6 Applicant contest that the pressures are not disclosed on the reference of Xu.

Examiner respectfully submits that pressure is a process-effective variable and finding the optimum ranges requires only ordinary skill in the art.

15. In regards to claim 10, Applicant contests that the power is never mentioned in the reference of Xu.

Examiner respectfully submits that Xu discloses the power at various places. Xu discloses that the maximum power that can be used is 24kW (Column 15, Line 43). Xu, then discloses that the power can be set at 1.5kW in "Process Example 2."

16. In regards to claim 12, Applicant discloses that Xu does not give a deposition rate for the seed layer.

Examiner respectfully submits that although Xu does not explicitly shows the deposition rate. Xu discloses that the seed layer is 2,000 Å and the deposition time is a reasonably short time (i.e. shorter than 3.5 mins.).

17. Applicant's arguments with respect to claims 14 and 15 have been considered but are moot in view of the new ground(s) of rejection.

18. In regards to claim 19, Applicant contests that the power is never mentioned in the reference of Xu.

Examiner respectfully submits that Xu discloses the power at various places. Xu discloses that the maximum power that can be used is 24kW (Column 15, Line 43). Xu, then discloses that the power can be set at 350 W in "Process Example 1."

19. In regards with the double patenting rejection, Applicant contests that Xu does not show the claimed temperature.

Examiner respectfully submits that although Xu prefers the deposition of 200°C. Xu discloses that the deposition of the Al seed layer can be done by the process of Wang, which suggests a cold deposition of 50 to 250°C (Column 24; Lines 12 – 13).

Teaching another way is a broad concept. It refers to a situation where a reference teaches a preferred, a better or an alternative way to a claimed way of accomplishing something. A reference must be considered for all it teaches. *Ashland Oil Inc. v. Delta Resins & Refractories Inc.*, 776 F.2d 281, 296, 227 USPQ 657, 666 (Fed. Cir. 1985). Preferred embodiments and disclosed examples do not constitute a teaching away from a broader disclosure or nonpreferred embodiments. *Merck & Co. v. Biocraft Labs.*, 874 F.2d 804, 807, 10 USPQ2d 1843, 1846 (Fed. Cir. 1989); *In re Mills*, 470 F.2d 649, 650, 176 USPQ 196, 198 (CCPA 1972). Similarly, a statement that a first product is somewhat inferior to another product for the same use does not teach away when the reference also discloses that the first offers acceptable advantages. *In re Gurley*, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994).

It is not necessary for Xu to disclose solving the same problem or obtaining the same advantages as the primary reference discloses. It is sufficient that there is

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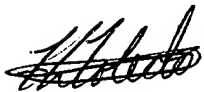
motivation to combine the references and that the process of the combination is encompassed by the instant claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fernando Toledo whose telephone number is 703-305-0567. The examiner can normally be reached on Mon-Fri 8am to 4pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 703-306-2794. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7382 for regular communications and 703-308-7382 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.



FToledo
July 16, 2003



George Fourson
Primary Examiner
Art Unit 2823